other plants to injure; but it is another matter to kill the same weeds growing in a lawn or a flower-bed, where we have to pay attention to the neighbouring plants.

Experiments in the open, simple in themselves, but conducted intelligently and with due regard to the rigorous demands of science, can alone determine these questions.

Brewers have long known that burning sulphur in the barrels will rid these barrels of the moulds and yeasts growing on their damp beer-soaked sides; and Berkeley saw clearly that sulphur could be applied to the outside of plants on which such fungi as the hop- or grape-mildew, &c., are growing, the critical period being when the spores are germinating, so that the slowly oxidising sulphur should evolve sulphurous acid in just sufficient quantities to destroy the delicate germs without injuring the leaves. And even better results have been attained with Bordeaux mixture.

But it is clear that this can only be done with an intelligent appreciation of the life-history of the fungus, and a knowledge of when the germinating stage is at hand. The successes obtained in France and America with Bordeaux mixture attest this.

It would obviously be absurd to powder sulphur or spray liquids over plants attacked by bunt- or smut-fungi, for we know that the germ-tubes only infect the germinating grain as its first root emerges. Here, as was shown long ago, and especially by the experiments of Hoffmann, Kühn, and De Bary, the practice known as "dressing the grain" must be followed. Knowing that the spores of the fungus are attached to the grain, or to particles of soil around, the efforts must be directed to covering the outside of the grain with an antiseptic which is strong enough to kill the germs but not the grain. If the land is known to be clean, the grain may be immersed in hot water, the temperature being experimentally determined, and high enough to kill the spores but not the wheat, and so on. In these matters also the American stations have done good work.

Neither of these classes of treatment can be adopted, on the other hand, for diseases such as "Finger and Toes," where we have a delicate slime-fungus making its way into the roots already in the soil; but, here again, intelligently devised experiments, such as those of Somerville and Massee, have shown that liming the soil renders it so unfavourable to this disease that it can be coped with.

And similarly with other diseases; the particular methods of dealing with the "damping-off" of seedlings, "dry-rot" in timber, the various diseases of trees, and so on, do and must differ in each case, and the guiding principle must be always the same—having learnt all that can be learnt of the habits of the fungus and of the host, and of the relationships of each to the other and the environment, to see how it is possible to step in at the critical moment and interfere with these relationships in the direction desired by human interests.

The whole matter thus resolves itself into a study of variation—a purely experimental inquiry into complex biological relationships, and it is encouraging to see that this is being understood in the large American and other stations, which are distinguishing themselves by their efforts.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE attendance of British geologists at this meeting of the Association was not large, owing, no doubt, to the counter-attractions of the International Geological Congress in Russia, which drew away also some American geologists who might otherwise have attended. But in spite of this, the section was, on the whole, well attended, and its work was exceptionally arduous and interesting. Though with the exception of the reports of Committees, there were only three papers exclusively British in their scope, the large number of contributions on North American subjects more than made up the deficiency, and gave to this meeting a distinctive character. It is significant of the vitality of earth study on the American side of the Atlantic that the papers should have been, upon the whole, well above the average of other meetings.

Contributions of merely local interest were almost absent, and again and again one was struck by the breadth of view and vigour of generalisation which marked the work submitted to the section. The presence of numerous distinguished Canadian and American geologists, many of the latter coming from the Detroit meeting of the sister Association, furnished an audience ready to grasp and to criticise the views brought forward, and in some instances discussions commenced in Detroit were continued in Toronto. It was, indeed, only the amount of work to be got through which limited the debates. The Glacial papers were exceptionally numerous and full of instruction for the European geologist, while that of Prof. Penck must have had a high interest for American glacialists. It was possible, on the day set apart for these papers, to arrange a series which should span the continent from the Atlantic to the Pacific, and thus to bring before the listener a comprehensive view of the whole bearings of the subject in North America. It is noteworthy that neither in the papers nor in the discussion was there a single dissentient from the view that ice-sheets covering the northern portions of the continent had formed the drifts. This seems to be taken as established beyond all doubt in North America.

Next after the Glacial papers in numbers and importance were those dealing with the Archæan and Palæozoic rocks, these again reflecting the locale of the meeting.

Petrological studies were also fully represented, but Palæontology was comparatively neglected, though a feature of the meeting was the special exhibition of several collections of North American fossils. Those to excite the greatest attention were the beautifully preserved trilobites showing the antennæ and pedal appendages, collected from the Utica Shales of Rome, N.Y., by Dr. C. E. Beecher, and exhibited by Dr. Ami.

The excursions arranged for the geologists were highly successful and most enjoyable. Niagara was visited under the leadership of Mr. G. K. Gilbert, of the U.S. Geological Survey; the inter-glacial deposits of the Don Valley and Scarborough Heights, under the guidance of Prof. A. P. Coleman; while Dr. J. W. Spencer pointed out the main features of the Iroquois Beach, a deformed post-glacial shore-line. Of the long excursion to the Pacific Coast, to which the Canadian Pacific Railway Co. has munificently invited a large party of members, it is at the time of writing too early to speak, but this is being anticipated by all invited as the fitting close of a most enjoyable and memorable meeting. The geologists on this excursion will be under the guidance of their President, Dr. G. M. Dawson, and their Secretary, Prof. A. P. Coleman.

The sectional work of the meeting commenced on Thursday, August 19, with the President's address, an able exposition of the present state of our knowledge respecting the most ancient rocks of Canada, of which, as it has already been given in full in our columns, it is necessary now only to record the favourable reception by the meeting.

Next followed a group of papers treating of the pre-Palæozoic and Palæozoic rocks of North America. Dr. L. W. Bailey described some typical sections in south-western Nova Scotia, in which he showed the succession of the Cambrian rocks of that region and their relation to the granite axis. Dr. R. W. Ells discussed problems in Quebec geology, dealing with the origin of the fundamental gneiss and the Grenville series, and their relations to the Hastings series and the oldest fossiliferous rocks. Mr. J. C. Branner traced the former extension of the Appalachians across Mississippi, Louisana, and Texas beneath the newer rocks.

A most interesting paper at this session was that of Dr. F. D. Adams and Mr. J. T. Nicholson, entitled "Preliminary notice of some experiments on the flow of rocks," in which the authors related how they had placed, accurately-fitting columns of Carrara marble about 4 cm. long by 2 cm. diameter, within specially prepared tubes of Swedish iron, and had subjected them to extreme pressure gradually applied. The rock yielded like a plastic substance, and bulged the enclosing tube. In one experiment the column was reduced from 40 mm. to 21 mm. in height, the deformed marble remaining quite firm and compact, though not so hard as the original rock. When sliced and examined microscopically, polysynthetic twinning of the calcite crystals and other indications of strain were observable. These very suggestive experiments are to be continued, and it is certain that all students of dynamic geology will follow the results with keen attention. At a later session Dr. Adams dealt with the structure and origin of certain rocks of the Laurentian system, his conclusions corresponding with those of European workers on rocks of similar type, since he showed by chemical analysis and microscopic examination that the foliated rocks included two distinct and separable types—the one almost certainly highly altered sediments, and the other of igneous origin.

At Friday's session most of the Glacial papers were read.

The wealth of material brought forward left but little time for the final discussion, but the whole sitting was practically a debate on the subject by the authors of the numerous papers. Prof. F. C. Chamberlin led the way with a professedly highly speculative thesis—a group of hypotheses bearing on climatic changes—which turned mainly on the question of the origin and persistence of the various constituents of the atmosphere, more especially of the carbonic acid. The author made a complete departure from the common view, by supposing the atmosphere to have begun as a tenuous envelope which has been subjected to depletion and enrichment during all subsequent time. The author has been led to a rejection of the nebular hypothesis, in favour of the theory of the growth of the earth by the ingathering of solid and gaseous particles. An application of these principles resulted in the conclusion that a glacial climate might be brought about by the impoverishment of the carbonic acid of the air; and a whole cycle of recurrent climatal changes was postulated on this basis.

In his next paper Prof. Chamberlin was content to confine himself to more mundane methods, and gave an able dissertation on the distribution and succession of the Pleistocene ice-sheets of the northern United States, illustrating, by means of a large map, the looped moraines which encircled the terminations of the various lobes. Prof. C. H. Hitchcock described the southern lobe of the Laurentian ice-sheet in New England, laying especial stress on the great uplift of the Laurentian boulders in their southward course, and the divergence of the striæ towards the termination of the lobe "like the barbs of a feather from the central shaft." Prof. H. LeRoy Fairchild discussed the general phenomena of the glacial geology of Western New York, bringing out forcibly the effect of the south-moving ice-sheet from the Ontario-Erie basin in damming the north-flowing drainage south of these lakes, so as to form temporary bodies of fresh-water which emptied southward across the water-shed at every col, cutting characteristic rock-channels now dry. Mr. F. B. Taylor gave an account of the Champlain submergence and uplift, and their relations to the Great Lakes and Niagara Falls, in which the point of chief importance was the description of an old channel by which all the great lakes, except Erie, formerly drained through the Nipissing outlet into the Ottawa river, thus enormously reducing the volume of Niagara, and consequently affecting very seriously any calculation as to the time occupied in the wearing back of the Niagara Gorge. This Nipissing outlet Mr. Taylor believes to have been finally closed by differential uplift, a factor which all the American geologists seem to recognise and allow in relation to glacial and post-glacial geology.

Prof. A. P. Coleman gave a lucid description of the glacial and inter-glacial deposits at Toronto. The recognised importance of these deposits to the vexed question of inter-glacial periods led to the formation of a Committee with a grant of 20*l.* to further investigate their flora and fauna. Dr. J. W. Spencer brought forward fresh evidence from the West Indies and elsewhere in favour of the continental elevation during the Glacial Epoch. At a later session Mr. J. B. Tyrrell, of the Canadian Survey, in a paper of wide scope, under the title of "The glaciation of North Central Canada," gave the result of his prolonged researches in the barren lands west of Hudson's Bay. He concluded that the glaciation of these great plains has been effected by ice radiating at different times from three centres of glaciation: the Cordilleran in the west, the Keewatin in the middle region, and the Laurentide or Labradorian in the east, and that there has been throughout the Glacial Period a progressive shifting westward of the centres of maximum glaciation. He found no evidence to denote any extensive pre-glacial elevation of the region. Mr. Tyrrell's observations cannot fail to modify considerably some existing views as to the cause and growth of ice-sheets. Mr. Bailey Willis, in his paper on the drift-phenomena of Puget Sound, and their interpretation, held that the hollows now occupied by the sea in that region were the casts of glaciers, and not, as has been supposed, the effects of submergence. Mr. R. Chalmers sent a contribution on the pre-glacial decay of rocks in Eastern Canada, in which were described the thick sheets of decomposed rock, of Tertiary age, which occur in sheltered positions where they have not been removed by glaciation.

Three papers dealing with European glacial geology, which were also read on Friday, afforded a clear indication of the similarity of the phenomena on the opposite sides of the Atlantic. Prof. A. Penck, in a general description of the glacial deposits of the Alps, compared their glaciation with that of British Columbia and Alaska, the glaciers pouring down the valleys to form Piedmont ice-lobes terminated by moraines. He thought that two inter-glacial epochs were indicated, each of much longer duration than post-glacial time, the proportions being stated as 1 : 4 : 6. Assuming the post-glacial period to have extended over 20,000 years, he conjectured that the two inter-glacial periods together occupied 200,000 years, and, from the evidence of the Poe Plain, that the entire glacial and inter-glacial periods lasted 500,000 years. While favouring Richthofen's eolian theory for the loess, he considered that the material had been originally derived from fluvio-glacial deposits. He recognised a slight folding of the older glacial strata, and held that the lakes, which all lay within the limits of the last glaciation, were deformed valleys deepened and widened by the ice-sheet and dammed by its moraines. He noted that there were abundant evidences for the existence of man during the last inter-glacial and glacial epoch; man's antiquity in Europe, therefore, being about 150,000 years.

Prince Kropotkin prefaced his paper on the Asar of Finland by explaining that his observations were made in 1871, and that the reason for his long delay was that in running away from his fortress-prison at St. Petersburg, he had to leave his MSS. behind, and had only lately recovered them through the good offices of the Russian Geographical Society. He demurred from the prevalent view that the Åsar have been formed in fluvio-glacial rivers, as he had in several instances found that they enclosed a hidden core of true morainic material.

Mr. H. B. Woodward's paper, on the chalky boulder clay and the glacial phenomena of the west-midland Counties of England, brought clearly forward the similarity of these English glacial deposits in their origin with those of North America.

Among the Petrological papers, which were chiefly taken at Monday's session, was that of Messrs. Barlow and Ferrier, on the relation and structures of certain granites and associated arkoses in Lake Temiscaming, Canada, in which they showed that in this region there was a gradual passage from granite to a stratified arkose, as the result of the decomposition and dynamic alteration of the former rock. They concluded that there has been "a pre-existing basement or floor essentially granitic in composition at the base of the Huronian." Prof. W. G. Miller gave a description of some nickeliferous magnetites from Eastern Ontario.

A valuable contribution by Mr. J. J. H. Teall, on differentiation in igneous magmas as a result of progressive crystallisation, was read in the absence of the author. Mr. Teall referred to certain rocks recently collected by the Jackson-Harmsworth expedition in Franz-Josef Land, as proving that magnetite may belong to a very late stage of consolidation, and that progressive crystallisation may lead to a concentration of iron-oxides in the mother-liquor.

The Palæontological papers were not numerous, perhaps partly because some which might be classed under this head were carried to other sections. A note was read from Sir W. Dawson, on certain pre-Cambrian and Cambrian fossils supposed to be related to Eozoon. Mr. J. F. Whiteaves described a Dendrodont tooth from the Upper Arisaig rocks of Nova Scotia, which he thinks may add a second vertebrate species to the Silurian in Canada. Dr. H. M. Ami had an interesting account of some new or hitherto little-known Palæozoic formations in North America, in which the author discussed the successive faunas of Ordovician age in New Brunswick and Nova Scotia. An important contribution from Dr. G. F. Matthew was also read by Dr. Ami, on some characteristic genera of the Cambrian, in which the horizon of *Olenellus* was especially discussed, the conclusion being that its place was above rather than below the *Paradoxides* beds, and therefore not at the base of the Cambrian system.

Mr. A. C. Seward's paper, on the possible identity of *Bennettites*, *Williamsonia* and *Zamites gigas*, explained with the aid of lantern illustrations, completes the Palæontological list.

On Tuesday, among other papers, Dr. E. W. Claypole gave a comprehensive account of the Palæozoic geography of the Eastern States, illustrating by lantern slides the chief geographical and hydrographical changes of the mid-Palæozoic era in that region.

Space forbids notice of the various Committees of Research, though several of these were of considerable interest, notably that on the secondary fossils of Moreseat, Aberdeenshire, by J. Milne and A. J. Jukes-Browne; that on erratic blocks, by

P. F. Kendall; that on the Irish elk in the Isle of Man, by P. M. C. Kermode; and on geological photographs, by Prof. W. W. Watts.

The final meeting of the section on Wednesday was devoted to a joint discussion with Section H, on the first traces of man in North America, in which the President of the Association, Profs. Putnam, McGee and Claypole, and Drs. Dawson and Spencer took part. Though no definite conclusion was reached, the general feeling of the meeting seemed to be against the high antiquity of the reputed finds in the Trenton gravels.

This completed the work of the section, and brought an extremely busy week to a successful termination. The Toronto meeting of the British Association, so far as Section C is concerned, must be regarded as well above the average of recent meetings, both in the quantity and quality of its work, and as one which all the geologists present will remember both with profit and pleasure.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

NATURALLY most of the papers read before Section H related to American anthropology; the following abstracts give some idea of the more important of the communications.

Miss A. C. Fletcher, who has a long and intimate acquaintance with the Omaha, gave a couple of papers on the Scalp-lock and the import of the totem among that tribe. Her sympathetic studies have thrown considerable light upon the religious conceptions of these people, and she has demonstrated that they can compose highly dramatic songs and music. In the legend of the Sacred Pole of the Omahas, we are told, "The people felt themselves weak and poor. Then the old men gathered together and said, 'Let us make our children cry to Wakonda.' So all the parents took their children, covered their faces with soft clay, and sent them forth to lonely places. The old man said, 'You shall go forth to cry to Wakonda. When on the hills you shall not ask for any particular thing; whatever is good, that may Wakonda give.'" Thenceforth on arriving at puberty the youth went fasting among the hills till he fell into a trance; whatever he then beheld in his sleep would be the special medium through which he could receive supernatural aid. This was his personal totem. He then banded himself with those who had received similar visions, and who formed a brotherhood or religious society. These were probably the most primitive social organisations. A further integration resulted in the grouping of brotherhoods into gentes, who practised exogamy and traced descent through the father. Each gens had its totem, which was probably that of the original founder of the gens.

The gentile totem gave no immediate hold upon the supernatural, as did the individual totem to its possessor; it served solely as a mark that the individual belonged to a definite kinship group from which he could never sever himself without incurring supernatural punishment.

The child entered into the gens by means of the ceremony of hair-cutting. As recently practised this rite consisted of two parts, of which the first was confined to boys. A child was presented by his mother to Thunder priest with the words, "I desire my child to walk long upon the earth, I desire him to be satisfied with much food, we seek your protection, we hold to you for strength." While singing a song the priest cut a tuft of hair from the crown of the head, and laid it away in the sacred case. The hair typified the life of the boy, which was thus symbolically entrusted to the safe-keeping of the Thunder god. The child thenceforth passes out of the simple relation he bears to his parents, and by this act is re-born into the tribe and becomes a recognised member of the tribe. The sign of this consecration is the small lock of braided hair, which is isolated from the rest, and to which is fastened the talisman and the war honours worn by the warrior. It was this lock that was cut from the head of a slain enemy and formed the central object in the triumph ceremonies, since it pre-eminently represented the life of the vanquished enemy. The second part was common to all children. In a symbolic ceremony the child was turned in the four quarters in order to place it in relation with the elements, and thus to ensure long life and prosperity.

Probably the turning ceremony was the more primitive portion, so that the sequence may have been much as follows: A child was put into harmonious relation with its environment by the rite of the "turning of the child." Then a boy was placed in the safe-keeping of the Thunder god, by means of the "hair-cutting" rite, that he might become a brave defender of his people. The need of the assistance of supernatural forces led to the "vision rite," with its consequent totem. Those having the same totem naturally formed brotherhoods, and which acknowledged spiritual affinities, and lastly kinship was recognised and relatives were bound together by a common totem, and the restrictions of a common tabu. This important paper will shortly be printed in full by the Anthropological Institute.

Mr. C. Hill Tout presented a long folk-tale, entitled "Sqaktktquacht, or the Benign-Faced"—an interesting hero-tale of a clever younger brother who went about doing good. He was the youngest of three brothers, who were the children of the red-headed woodpecker and his wife, the black bear. This saga will be published by the Folk-lore Society.

A legend concerning Scar-face, which is believed by the Algonquian Blackfeet to explain the origin of their principal sacred ceremonies, was sent by Mr. R. N. Wilson. So much ritual has reference to this myth, and so many observances are founded upon it, that the student of Indian religious thought may accept it as one of the most significant and instructive of their legends. A beautiful Indian girl refused many suitors, but promised to marry one young man if the scar that disfigured his face could be removed. After a long journey he came to where the Sun lived with his wife, the Moon; their son, the Morning Star, befriended Scar-face. The Sun healed him and retained him until he had been taught many religious ceremonies. Eventually he returned home, married the girl, and taught the ceremonies to his tribe, and the Sun, as he had promised, was kind to the people and heard their prayers. Mr. Wilson's other paper gave a detailed account of Blackfoot Sun-offerings. The tribal religious ceremonies are performed by "prayerful" men; they are not members of any society, but simply individuals of an extremely religious temperament gifted with a good memory. There is no medical priesthood, as has been inaccurately stated. The Sun is pre-eminently the Blackfoot divinity; they may have had more ancient deities, but the "Creator" was never heard of by them until the advent of the missionaries. An account of the life of the Blackfoot women was given by the Rev. J. Maclean. According to Mr. Stansbury Hagar, who presented a paper on the star-lore of the Micmacs of Nova Scotia, the Micmacs believe the stars to be the camp fires of the inhabitants of the sky. The larger fires are before the dwellings of the chiefs, and around them are grouped the lesser lights of the people who bear the same totem name. The Milky Way is the road between heaven and earth. The four stars of the body of the Plough are known as the Bear. He is pursued by seven birds (the three stars of the Plough-handle, Arcturus and γ, ϵ, and υ of Boötes). Near the second of these hunters is a faint star representing the kettle in which the bear is to be cooked. Behind them the Northern Crown with μ and ν of Boötes form a typical den. In the spring the bear is seen climbing out of his den; in summer he runs across the sky; in the fall, overtaken by his pursuers, he is wounded with an arrow and totters to the ground; in winter he lies dead upon his back, but with the following spring returns to life, and so the cycle continues eternally.

Dr. W. J. McGee gave a graphic account of the Seri Indians of the Gulf of California. This very ancient tribe has been so isolated that it had never before been studied. These cannibals are extremely active and warlike; they use poisoned arrows, and owing to their bellicose disposition they are now nearly extinct. They are more distinctly matriarchal than any other tribe, and were originally monogamous, though now they are polygamous. They live entirely by fishing and the chase, and have no agriculture. Their implements are natural stones, which by use may become pounded into more serviceable shapes; for these the term "protolithic" was suggested. A cultural art has been but recently acquired, as there is no name in general use for the chipped arrow-points that they now employ.

The Kootenays and Salishans of British Columbia were described by Dr. A. F. Chamberlain; though allied in many respects, they belong to two distinct linguistic stocks. The former are intensely democratic and without complicated secret societies or totemistic clans. Sun-worship is strongly developed among them. A large series of interesting Kootenay drawings was exhibited by the author.

A summary of the twelfth report of the Committee appointed to investigate the North-western tribes of Canada, by